II.D.4 High-Performance, Durable, Pd-Alloy Membrane for Hydrogen Separation

Andrew Payzant (Primary Contact),
James Hemrick
Oak Ridge National Laboratory (ORNL)
Post Office Box 2008
Oak Ridge, TN 37381-6064
Phone: (865) 574-6538; Fax: (865) 574-3940
E-mail: PayzantA@ornl.gov

DOE Technology Development Manager:
Arlene Anderson
Phone: (202) 586-3818; Fax: (202) 586-9811
E-mail: Arlene.Anderson@ee.doe.gov

Project Start Date: April 2007
Project End Date: September 2008

Objectives

- To provide advanced characterization and mechanical measurements of the palladium (Pd) alloy hydrogen gas separation membranes synthesized by Pall Corporation.
- Determine Pd alloy formation kinetics and microstructure.
- Test high temperature *in situ* mechanical properties of Pd foils and substrates.

Technical Barriers

This project addresses the following technical barriers from the Hydrogen Production section of the Hydrogen, Fuel Cells and Infrastructure Technologies Program Multi-Year Research, Development and Demonstration Plan:

(A) Reformer Capital Costs
(K) Durability
(P) Flux
(R) Cost

Technical Targets

This project is conducting fundamental materials support studies on metal supported Pd alloy hydrogen separation membranes, originating from Pall Corporation and the Colorado School of Mines. Insights gained from these studies will be applied toward the design and synthesis of hydrogen separation materials that meet the DOE 2010 hydrogen separations targets with respect to:

- Mechanical strength
- Cost (through optimization of the processing parameters)

Approach

ORNL will provide unique capabilities in materials characterization - time-resolved high-temperature X-ray diffraction (XRD) analysis of Pd-Cu alloy membranes under controlled atmospheres, high-resolution electron microprobe analysis of the membrane microstructure, and high-temperature *in situ* mechanical testing of the tubular supports and foils. Membranes to be tested will be fabricated by Dr. Douglas Way (Colorado School of Mines), on substrates provided by Dr. Rick Kleiner of Pall Corporation. Although the project was conceived around providing unique materials development support to the Pall project, it is expected that the results will be useful across other DOE-supported research involving high-temperature supported membranes.

High temperature tensile testing of membrane/substrate tubes will be performed with a MTS 810 Material Test System utilizing hydraulic grips and a clamshell furnace. High temperature bladder collapse testing will comprise the pressurizing of a pressure vessel at temperature to create a collapsing stress on the membrane/tube assembly. Breakage of the tube will be indicated by a change in pressure of the interior of the tube and will be monitored by digital pressure transducers. High temperature tensile testing of the foils will be carried out using a foil test system consisting of a pneumatic actuator which applies a tensile stress to the foil in a controlled environment (atmosphere/temperature).

High-temperature XRD will be used to study the phase evolution of palladium alloy precursor films and lattice thermal expansion in simulated environments, including pure hydrogen gas.

Accomplishments

The project was initiated in April 2007. Experimental work is scheduled for September 2007.